

LANGLEY SUB-LIBRARY

**CASE FILE
COPY**

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

T.M. 187

TECHNICAL SECTION OF AERONAUTICS.

By André Lesage.

From "Le Genie Civil," July 15, 1923.

FILE COPY

To be returned to
the files of the National
Advisory Committee
for Aeronautics.

NATIONAL LIBRARY
LANGLEY AERONAUTICAL LABORATORY
Langley Field, Va.

February, 1923.

TECHNICAL SECTION OF AERONAUTICS.*

By André Lésage.

The "Service Technique de l'Aéronautique" (S.T.Aé.), under the direction of Naval Constructor Fortant (with the rank of Captain), constitutes one of the three grand divisions of the Under-Secretariat of State for Aeronautics and Aerial Transportation, the other two divisions being the "Service des Fabrications de l'Aéronautique" (S.F.Aé.) and the "Service de la Navigation Aérienne" (S.N.Aé.).

The duties of the Technical Section of Aeronautics are:

1. To prosecute technical investigations and all experiments pertaining to aircraft.
2. To promote Aeronautic science and the practical use of aircraft, by undertaking or stimulating research, tending to improve their quality, power, conditions of use and safety;
3. To inform the Under-Secretary of State for Aeronautics concerning the possibilities of producing aircraft adapted to the needs of the various ministerial departments;
4. To collaborate in the drawing up of Aeronautic programs and to communicate them to constructors, to guide the latter in the study of projects adapted to the programs by coordinating their efforts with a view to avoiding useless research;
5. To recommend to the Under-Secretary of State for Aeronautics the adoption of suitable types of aircraft, in conformity with the programs of the various Government departments and

* From Le Génie Civil, July 15, 1922, pp. 54-59.

** Translated in Office of Naval Attaché, Paris.

best adapted to their needs, as likewise all possible modifications likely to improve the value of aircraft already in service;

6. To supply the department whose duty is to look after quantity production, with all the technical documents necessary for placing orders and making contracts;

7. Lastly, to establish technical rules for the employment of aircraft and to superintend technical tests permitting the award of certificates of navigability to civil aircraft and of subsidies to aerial navigation companies.

The interior organization of the S.T.Aé. is based on the principle of complete separation of theoretical investigations and experimental work.

This separation, which may at first thought, seem to present difficulties, is in reality the best method of securing division of labor and impartial reports. It is unavoidable, in fact, for a department which has formed, through the examination of records, a previous opinion, not to have, despite its desire to be impartial, a tendency to direct its experiments along a line unconsciously dictated by the examination of said records. The independence of these two departments, under the control of a director assuring immediate and constant cooperation, gives, on the contrary, the most complete guaranty of technical impartiality.

The Research Department, directed by Naval Constructor SABATIER (with the rank of Commander), has a certain number of

sections (aviation, hydro-aviation, aerostation, engines and propellers, navigation, radio and photography, rigging). The experimental department is itself divided into two distinct sections, that of laboratories and research, and that of tests properly so termed, under the supervision of Naval Constructor DUMANOIS (with rank of Lieutenant Commander).

The plants of the S.T.Aé. are located at Issy-les-Moulineaux (Fig. 1), in new buildings especially erected for them.

At Issy-les-Moulineaux we likewise find laboratories for the Research Department, comprising, in particular, one for chemistry, a physical laboratory, an optical and a photographic laboratory, one for mechanical tests, one for thermic treatment, one for electricity, and one for the study of woods, fabrics and dopes (Fig. 1). A large wind tunnel (Fig. 2) will be in operation in the near future and will permit obtaining, with a power of 1000 kilowatts, an air current of uniform velocity, as high as 80 (262.47 ft.) meters per second, with a diameter of three meters (9.84 ft.). These different laboratories are under the direction of Commandant ROBERT and we shall have occasion to revert to them in a future article.

The plants of Issy-les-Moulineaux also include the necessary shops for the construction of new apparatus and airplanes, engines and accessories, which cannot be entrusted to civil industry, either because they are of a confidential nature, or because their inventor may have only submitted an interesting project which he has not the means of carrying out.

It is thus seen that the plant at Issy-les-Moulineaux constitutes a real center of Aeronautic Investigation and production, so that when the plant shall have been completed and assigned the necessary personnel for obtaining its maximum output, it will have no cause to envy similar institutions abroad.

There is also an information section and an Aeronautical Museum at Chalais-Meudon under the supervision of the Director of the S.T.Aé.

Before the constructor can be authorized to fly a new airplane, he has to submit it, under the supervision of the S.T.Aé. to a series of static tests, with the object of demonstrating that the airplane in question satisfies certain conditions of strength required in the use for which it is designed.

The static tests made on all airplanes are as follows:

- (a) Static test of cell, underneath;
- (b) Static test of cell, above;
- (c) Unsymmetrical test of cell;
- (d) Static test of fuselage for flexure and torsion;
- (e) Static test of tail planes, wheels, axles, and skids.

The required factors of safety vary according to the method followed in the construction of the airplanes and the category to which it belongs (pursuit, reconnaissance, observation, bombing, colonial, public transportation, postal or touring airplanes, high-sea seaplanes, torpedo seaplanes, coast seaplanes, commercial seaplanes, amphibians, and gliders).

The tests are made by loading the surfaces with bags of sand arranged in such a way as to distribute the stresses (with the required factor of safety) the same as under normal conditions of flight. Each member of the structure not possessing the desired factor of safety and of which the minimum strength could not be determined by calculation, will thus be exposed.

Moreover, any new part, any new process of manufacture or assembling (riveting, soldering, swaging, formation in matrices or dies, canvas working, varnishing, etc.) must likewise be the object of special tests under the supervision of the S.T.Aé.

The Testing Section, under the supervision of Naval Constructor Dumanois, is responsible for all tests of full-sized aeronautic materiel. The first category of tests includes those relating to engines and their accessories. These tests are now made on the test benches at Chalais-Meudon and will ultimately be made likewise at Issy-les-Moulineaux, in a shop now under construction, which will, in addition, include a vacuum chamber for studying functioning of engines in rarefied air.

The second category of tests comprises those relating to airplanes properly so called, or to aerial Navigation and aerodynamic experiments with full-sized airplanes. These tests are conducted at the Villacoublay airdrome, commanded by Captain Ceccaldi (Fig. 3).

They may be divided into three categories:

1. Flight tests: determination of the performances of airplanes (speed, ascent, endurance and manageability);

2. Tests with the object of finding conditions of safety in Aerial Navigation, the adjustment and improvement of navigation instruments (drift-meter, navigraph, etc.);

3. Tests relating to radiotelegraphy and radiotelephony (for communication with ground stations and between airplanes).

We shall briefly analyze each of these three classes of tests.

1.- Flight tests - The object of flight tests is to determine the performances of airplanes.

By "performance" is meant: The length of the "take-off" and that of landing; the rates of climb and the horizontal velocities at each altitude; and lastly, the ceiling.

For a given airplane, equipped with a given engine and a given propeller and carrying a given load, the performances are not constant. They depend:

- 1.- On the power developed by the engine;
- 2.- On the atmospheric conditions at the time of flight.

When the engine is well adjusted, the power varies very little during the tests. On the other hand, the atmospheric conditions are essentially changeable and it is necessary to correct the rough results of experiments, if it be desired to compare them with results obtained under other atmospheric conditions.

By way of example, let us select an airplane which, under average conditions, has a ceiling of 6200 meters, attains a speed of 180 kilometers per hour at 4000 meters (apparent altitude) and takes 18 minutes to attain this altitude. If we perform the

test in summer at a temperature of 25°C (on the ground), the ceiling is but 6100 meters, the speed is 182 kilometers per hour at the apparent altitude of 4000 meters and it requires 19 minutes and 15 seconds to attain it. On the other hand, if the test takes place during the winter at a temperature of -5°C , the ceiling mounts to 6450 meters, the speed drops to 174 kilometers per hour and the time of climb to the apparent altitude of 4000 meters is not more than 14 minutes and 50 seconds.

It is, therefore, absolutely necessary to define an ideal atmosphere of comparison, to which all tests shall be reduced. The name of "standard atmosphere" has been given to this ideal atmosphere.

Definition of Standard Atmosphere. - In order that the reduction of actual tests to a standard atmosphere may hold good, it is essential that, at the corresponding points of the actual atmosphere and of the standard atmosphere, the forces operating on the airplane in flight be the same.

Now these forces are of three kinds:

1. - Forces due to the action of the air;
2. - Forces due to gravity;
3. - Forces due to the engine group.

The first are proportional to the density and to the viscosity of the surrounding air. The second are practically constant for the altitudes attained. The last are, on the other hand, bound up with atmospheric variations by complex laws, differing for different engines. However, experiments made in different countries,

on engines of very different designs have shown that, up to densities corresponding to an altitude of about 6000 meters, it might be assumed that the engine couple varied proportionally to the density of the surrounding air, the error being of the nature of experimental errors.

It follows therefore that all the forces at work depend only on the density of the air. Consequently, the standard atmosphere should be defined by a simple law of correspondence between densities and altitudes, without regard to pressure and temperature. Unfortunately, this would oblige us to register directly the densities of the surrounding air. Now, we have not, as yet, any apparatus which automatically registers these densities. We only have barographs and thermometers. We are thus forced to resort to the more directly measurable factors of pressure and temperature.

The law governing the distribution of temperatures as a function of the altitude has been chosen as a basis. This law of temperatures has been made as simple as possible, but still sufficiently close to the mean law of annual temperatures to make the corrections to be applied to the experimental measurements as small as possible. The law adopted is the following:

From 0 to 11000 meters, the temperature decreases as a linear function of the altitude, at the rate of 6.5° per kilometer, the temperature at the earth's surface being 15°C .

Above 11000 meters, the temperature is constant and equal to -56.5°C .

Through the application of the law of perfect gases and the formula of Laplace, there is at once obtained the law of distribution of pressure and densities.

1.- From 0 to 11000 meters:

$$\text{Temperature Law: } \theta_z = 15^\circ - 0.0065 z$$

$$\text{Pressure Law: } \frac{H_z}{H_0} = \left(\frac{288 - 0.0065 z}{288} \right)^{5.255}$$

$$\text{Density Law: } \frac{a_z}{a_0} = \left(\frac{288 - 0.0065 z}{288} \right)^{4.255}$$

2.- Above 11000 meters:

$$\text{Temperature Law: } \theta_z = - 56.5^\circ$$

$$\text{Pressure Law: } \log \frac{H_{11000}}{H_z} = \frac{z - 11000}{14600}$$

$$\text{Density Law: } \frac{a_z}{a_{11000}} = \frac{H}{H_{11000}}$$

in which z designates the altitude expressed in meters.

The numerical coefficients correspond to the following initial conditions:

$$d_0 = +15^\circ ; \quad H_0 = 760 \text{ mm} ; \quad a_0 = 1.225.$$

MEASURING INSTRUMENTS.- The quantities to be measured are: Pressure, temperature, revolution speed of engine and speed of airplane along its trajectory.

The pressure is recorded by a Richard barograph which is suspended elastically in the cockpit. Just before the "take-off" the index is placed at a fixed origin of 750 millimeters. Since

the indications of these instruments depend on the rate at which the pressure varies, they are compared every month by means of a pneumatic bell or receiver. There are thus obtained for each barograph the "lag" corrections to be applied to the readings taken during flight. In general, the lag is nil during the upward flight, but it may reach 12 millimeters during the descent. It is taken into account in determining the data. The instrument only indicates the static pressure in the interior of the cockpit, and not in the surrounding air; but the difference is slight (1%) as long as the speed of 180 kilometers per hour is not exceeded.

It has not been possible thus far to record the temperature under favorable conditions, on account of the slowness with which the thermographs assume their equilibrium. We have had to be contented with having the pilot take the readings of an alcohol thermometer secured to one of the struts of the cell. In order to be sure that the thermic equilibrium has been obtained between the thermometer and the surrounding air, the readings are taken at the end of the horizontal flights made at the different altitudes (See Table II, right-hand column).

The velocities of rotation are registered by means of mechanical recording tachometers of the Jaeger or Tellog type. These instruments are of medium size and sufficiently accurate, since they give the number of revolutions per minute, to within less than 10 for 1500-2000 R.P.M.. They are designed to be mounted on the end of the cam shaft and turn at half the speed of the crank shaft.

Lastly, the velocities of translation are measured by dynamic pressure indicators using a Pitot or a Venturi tube. The Toussaint-Lepère (T.L.) utilizes both. The Badin is a double Venturi tube. The indications of these instruments are therefore proportional to $V^2 a$, the square of the velocity times the density of the air. In order to facilitate the reading, the registering device is designed so as to record the square root of this quantity, $V\sqrt{a}$. For air of constant density, the indications are then proportional to the velocity of translation and the curve is a straight line. Unfortunately, this line varies for the same instrument, according to the circumstances attending its use. It is not the same in a wind tunnel as on an airplane. On the same airplane, it depends on the location selected. It is important therefore to protect the speed indicator as much as possible from injurious influences of the airplane, and to calibrate its readings on the airplane itself. A good location is, in general, obtained by placing the speed indicator at the end of a rod in the plane of the outermost struts, between the two wings and at 1.5 meters from the nearest leading edge.

Execution and tabulation of tests.— The first thing to do is to adjust the speed indicator. To this end, the airplane is made to pass over a perfectly known base, at the two extremities of which observers take the time with stop watches. In order to allow for the longitudinal component of the wind, a second flight over the same base is made in the opposite direc-

tion, at the same altitude and engine speed. No account is taken of the transverse velocity of the wind, as these tests are only conducted when the wind is very constant and of low velocity (3 to 3 meters per second at most). Under these conditions, the mean of the measured speeds V_c corresponds to the average of the readings n of the speed indicator (Table I). This only holds good, however, for the density corresponding to the pressure H and at the temperature θ of the test. In air at 760 millimeters and 15°C , the speed V which corresponds to the reading n would be such that $V^2 a_0 = V_c^2 a$, or:

$$V = V_c \sqrt{\frac{H}{760} \times \frac{288}{273 + \theta}}$$

By repeating the same test at different engine speeds, but at the same altitude and by making each flight at the same engine speed in both directions, we obtain a series of values $n_1, n_2, \dots$ to which the speeds $V_1, V_2, \dots$ will correspond. If the mounting of the speed indicator is good, and if the test has been well executed, the points obtained with reference to the axes V and n will lie practically in a straight line (Fig. 4). We shall be content, in general, with determining this line by means of three points corresponding to possible maximum and minimum flight speeds on the ground and to an intermediate speed.

After this adjustment is finished, all is ready for measuring the performances of the airplane. For this purpose, the airplane must rise to an altitude as near as possible to its

ceiling and execute, in descending, a series of horizontal flights at full speed and at altitudes differing by a thousand meters.

Ascent. - The ascent should be made at a constant angle, as experience shows that under these conditions, the curve of the climbing speeds, as a function of the altitude, is practically a straight line (Fig. 5). We have here, therefore, a simple means of determining the theoretical and the practical ceilings, the latter being, by definition, the altitude at which the rate of climb is 0.5 meter per second.

In the course of such a climb, experience shows and theory confirms, that the reading of the speed recorder must decrease very slightly, as can be seen in Fig. 6.

The object of the climbing test is to determine the climbing speeds and times to different altitudes, expressed in terms of the standard atmosphere. It is therefore necessary to reduce the barogram obtained experimentally (Fig. 7) to the standard atmosphere.

To do this, we commence by referring it to rectangular axes (OH, Ot), at the same time taking into consideration the difference between the pressure at the moment of take-off (758 for the example selected) (Fig. 9).

If AB is the curve obtained, the whole problem consists in finding, for any point C, the corresponding point C' in standard atmosphere. To do this, we lay off at the left of OH, the curve of the temperatures as a function of the pressures H,

on the one hand, in terms of standard atmosphere (solid line), on the other hand, in terms of the actual atmosphere (interrupted line), and indicate on the standard curve the altitudes at intervals of 500 meters: $\alpha, \beta, \gamma, \delta, \dots$

All the possible real points, which correspond to a point γ of the standard curve, have the same density as the point γ . Consequently, they are found on the same straight line passing through the point γ and the point $H = 0; \delta = -273$. On drawing this line, it cuts the curve of temperatures obtained on the day of experiment at a point c , which corresponds to the point C of the actual diagram. By drawing the straight lines of constant density through $\alpha, \beta, \gamma, \delta, \dots$, we can obtain the points $A, B, C, D, \dots$ of the real diagram corresponding to the standard altitudes $0, 500, 1000 \dots$

But this does not give us the point C' . We only know that it is on the horizontal line passing through γ . In order to find this point C' , it suffices to observe that the climbing speed is the derivative of the altitude taken as a function of the time, and that the density is, except for the sign, the derivative of the pressure as a function of the altitude:

$$v_z = \frac{dz}{dt}; \quad a_z = - \frac{dH}{dz}$$

Since the homologous points C and C' , v_z and a are the same, it follows that $\frac{dH}{dt}$ is the same, i.e. the tangents to the two barograms are parallel. On replacing the tangents by the chords BC and $B'C'$, we can write, with sufficient approximation:

$$\frac{\Delta t'}{\Delta H'} = \frac{\Delta t}{\Delta H} \quad \text{or} \quad \Delta t' = \Delta t \frac{\Delta H'}{\Delta H}$$

Knowing the point B', it will therefore be possible to determine the point C', and so on. As for the point A', it coincides with the point O.

The series of practical operations is contained in Table III, which gives immediately the rates of climb at each altitude and enables the determination of the theoretical ceiling which is 6,500 meters (Fig. 5).

Horizontal velocities at different altitudes. - Having arrived at the maximum attainable altitude, the pilot makes his first horizontal flight of five minutes, keeping the readings of the barograph and tachometer constant. In the example considered (Figs. 6, 7, 8), the level stretch was somewhat shortened and the tachometer readings are not clearly distinguishable from those obtained during the climb (Fig. 8). As for the T.L. (Toussaint-Lepère/^{instrument}), it gave increasing readings, except in the case of a short level flight at reading 41 (corrected to 33 from the reading 8 at rest), corresponding to a short horizontal flight at 362 of the barogram (370, figure obtained by correction from the difference 758-750. See above). To the reading 33 of the speed recorder, there corresponds a speed of 95.5 kilometer/hour in an atmosphere at 760 millimeters and 15°C (Fig. 4). In an atmosphere of 370 mm (barometer) and -13.25°C (temperature measured at the end of the horizontal flight. See Table II), there corresponds to this reading a velocity of:

$$V = 95.5 \sqrt{\frac{760}{370} \times \frac{259.75}{238}} = 130 \text{ km/hr.}$$

The same procedure is followed for the succeeding horizontal runs, but taking into consideration at the same time, the hysteresis or "lag" of the barograph. For the barograph employed, this "lag" was 10 mm for the first two horizontal runs, and 12 millimeters for the last three.

These operations are tabulated in Table IV.

Lastly, we have in Tables III and IV all the elements necessary for following the performances under consideration. There are only lacking the lengths of the "take-off" and landing, which are easily determined by the usual topographical methods.

Table I. - Copy of a flight test record.

Farman airplane No. 01, Type 110 A . Salmson engine Z 9.

Test No. 2	Place: Villacoublay
Pilot: Lt. Cousin	Barometer on ground: 741 mm.
Date: April 5, 1922	Temperature" " : 4°C
Start: 10 A.M.	Finish: 10.35 A.M.
Wind: very weak	

Versailles

Choisy

Direction: S-W

R.P.M. 1500

No.	Post V	Post C	Time	Speed	Ave.	R.P.M.
1	3-07-1	1-31-8	1-35-3	173.8	177.150	1575
2	5-28-5	7-00-2	1-31-7	180.5		
3	11-15-2	9-21-6	1-53-6	145.6	149.350	1375
4	13-30-3	15-18-4	1-48-1	153.1		
5	20-41-2	18-10-2	2-25-0	114.2	119.100	1170
6	23-16-6	25-30-0	2-13-4	124.0		

Table II. - Data noted on a record similar to the above during a climbing test.

Altitudes	Climbing R.P.M.	Horizontal R.P.M.	Air temperatures	
			Climbing	Horizontal
1000	1440	1550	+17.5°C	+16.5°C
2000	1430	1540	+ 8.5°C	+ 9.5°C
3000	1425	1530	+ 5°C	+ 4.5°C
4000	1425	1510	- 1.5°C	- 1°C
5000	1435	1480	- 6.5°C	- 5.75°C
6000	1420	1450	-12.5°C	-13.25°C

Barometric pressure read	Barometric pressure corrected	Actual difference in pressure	Standard difference in pressure	Actual climbing time (in seconds)	Actual time intervals	Standard time intervals	Standard climbing time (in min. and sec.)	Standard altitudes	Standard climbing speeds	N	n	Speed corresponding to 1500 and 760 mm.	Correction of density	Vm	Actual speed on trajectory
	H	ΔH	$\Delta H'$	t	Δt	$\Delta t'$	t'	z	v _z	N	n	Speed corresponding to 1500 and 760 mm.	$\sqrt{\frac{5Q}{2g}}$	Vm	Actual speed on trajectory
755	763	36	44.2	105	105	129	2' 10"	500	3.85	1450	38	105	1.012	106.5	106.5
719	727	34	41.8	230	125	154	4' 45"	1000	3.25	1440	33	95	1.037	98.5	98.5
685	693	44	40	410	180	164	7' 25"	1500	3.05	1450	29	87	1.063	92.5	92.5
641	649	40	38.1	610	200	190.5	10' 35"	2000	2.60	1450	26	81	1.09	88.4	88.4
601	609	36	36.5	815	205	208	14' 05"	2500	2.40	1450	25.5	80	1.117	89.2	89.2
565	573	33	34	1050	235	242	18' 05"	3000	2.05	1430	22.5	74.5	1.146	85.5	85.5
532	540	32	32.4	1320	270	273	22' 40"	3500	1.95	1430	21	71	1.176	83.5	83.5
500	508	31	30.4	1620	300	294	27' 35"	4000	1.70	1430	21	71	1.207	85.7	85.7
469	477	29	29.9	2040	420	433	34' 45"	4500	1.15	1430	20.5	70	1.239	86.8	86.8
440	448	29	28.1	2510	470	455	42' 20"	5000	1.10	1430	21	71	1.273	90.5	90.5
411	419	25	25.7	3240	730	750	54' 50"	5500	0.65	1425	22	73	1.308	95.5	95.5
386	394	24	25.5	4360	1120	1190	74' 40"	6000	0.40	1420	22	73	1.344	98	98

Table IV. - Horizontal speed tests.

Measured pressure	Observed temperature	Standard altitude	R.P.M.	Reading of the T.L.	Speed corresponding to 15°C and 760 mm	$\sqrt{\frac{a_0}{a_z}}$	Real speed
370	-13.25°	6000	1460	33	95.5	1.36	130
440	- 5.75°	4650	1490	39	107	1.266	135.5
490	- 1°	3800	1520	45	118.5	1.21	143.5
552	+ 4.5°	2800	1530	49.5	127.5	1.15	146.8
628	+ 9.5°	1750	1550	55	138.5	1.09	151
698	+16.5°	950	1570	60	148.5	1.047	155.5

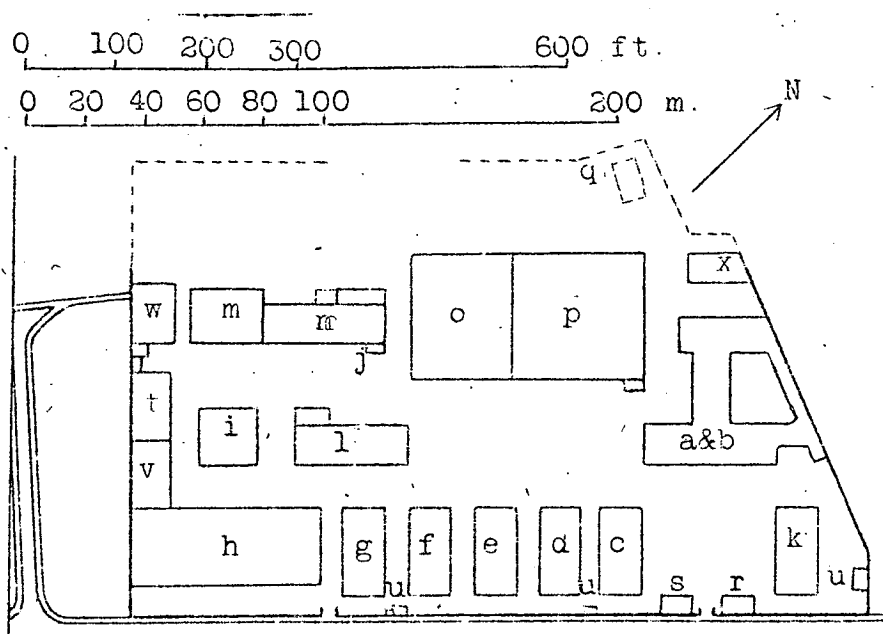


Fig.1 S.T.Ae.Plants at Issy-les-Moulineaux

- a & b: Offices and heating plant
- c: Optical and photographic laboratories
- d: Chemical laboratory
- e: Electrical "
- f: Laboratory for dynamic tests
- g: " of materials
- h: Large wind tunnel
- i: General store room
- j: Room for examining engines after tests
- k: Garage for motor trucks
- l: Supply room
- m: Engine-testing room
- n: Special engine laboratories
- o: Workshop
- p: Shed for assembling and shipping airplanes
- q: Laboratory; r: Bicycle room; s: Watchman
- t: Small wind tunnel; u: Latrine
- v: Central electric station; w: Printing room
- x: Meteorological room

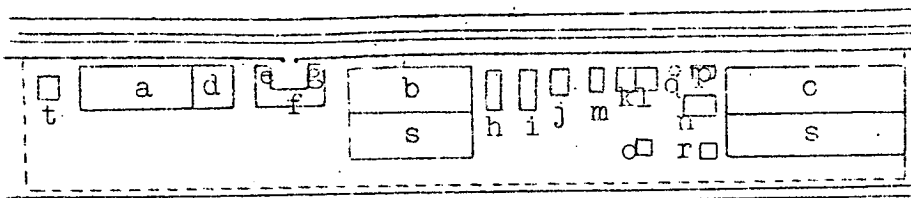


Fig.3 S.T.Ae.Plants at Villacoublay

- a: Dubois hanger 125x30x6m (410x98.4x19.7ft.)
b: Champeau hanger 100x35x10m (328x114.8x32.8ft.)
c: " " 150x35x15m (492x114.8x49.2ft.)
d: Workshop; e: Workshops of precision and inspection
f: Office; g: Store room; h-i: Barracks
j: Garage; k: Store room annex; l: First aid
m: Community room for civil personnel
n: Radio workshops; o: Radio sending and receiving sta.
p: Infirmary; q: Water tank; r: Searchlight
s: Concrete floor; t: Testing bench.

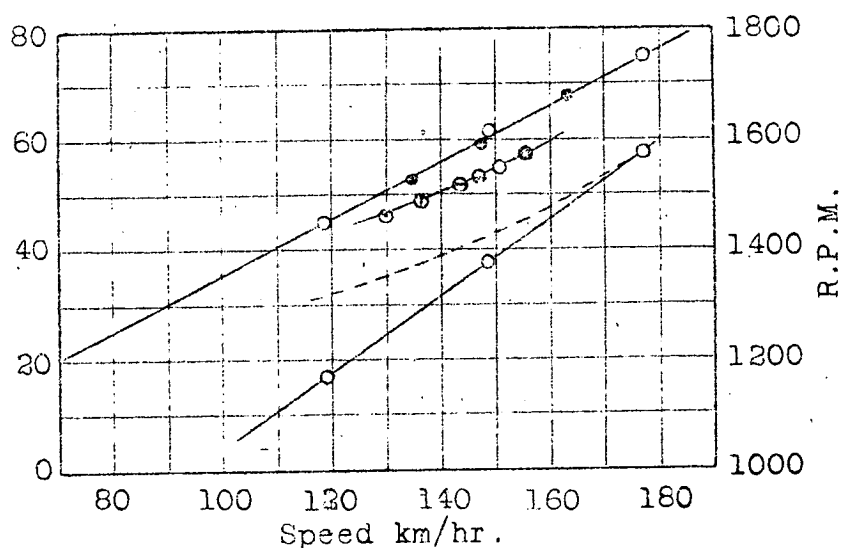


Fig.4 Adjustment of Toussaint Lepere instrument on Farman airplane 11C-A² No.01. Test of April 5, 1922

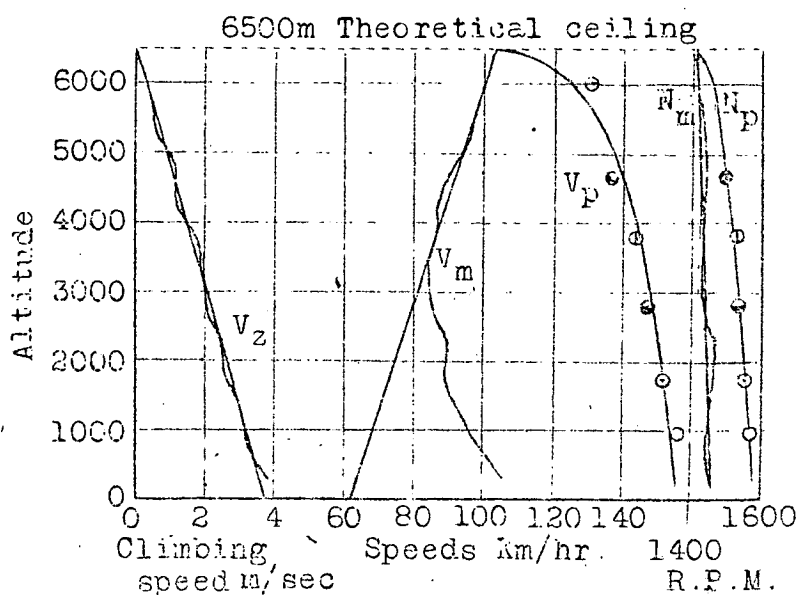


Fig.5. Curves of R.P.M. and speeds in terms of altitude.

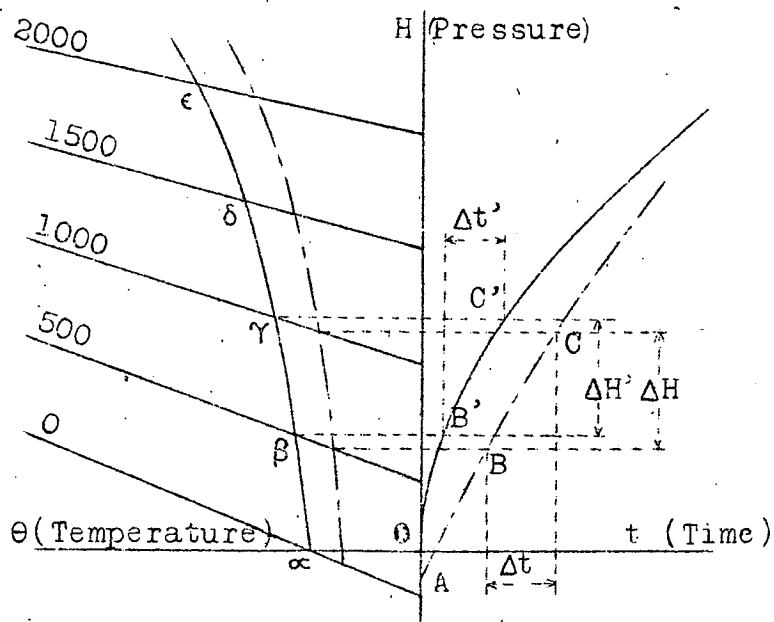


Fig.9 Reduction of experimental barogram to standard atmospheric conditions.

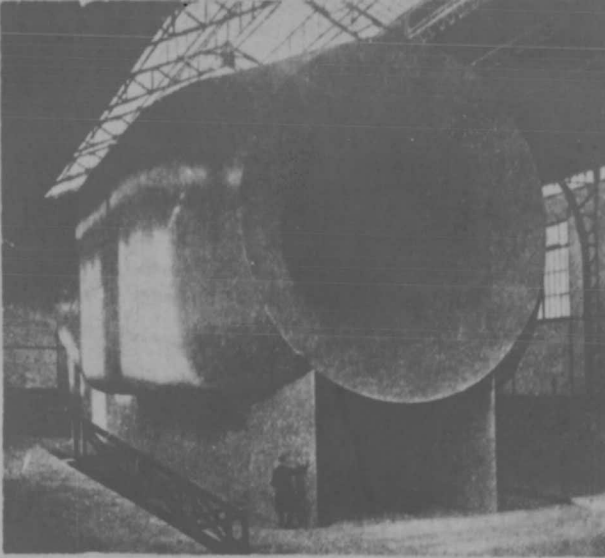


Fig. 2- Large wind tunnel

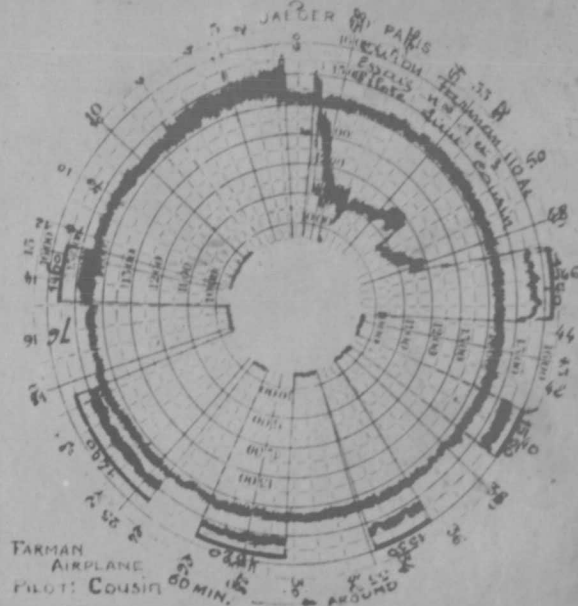


Fig. 3.- Diagram made by Jaeger tachygraph on which were obtained the results shown in table II

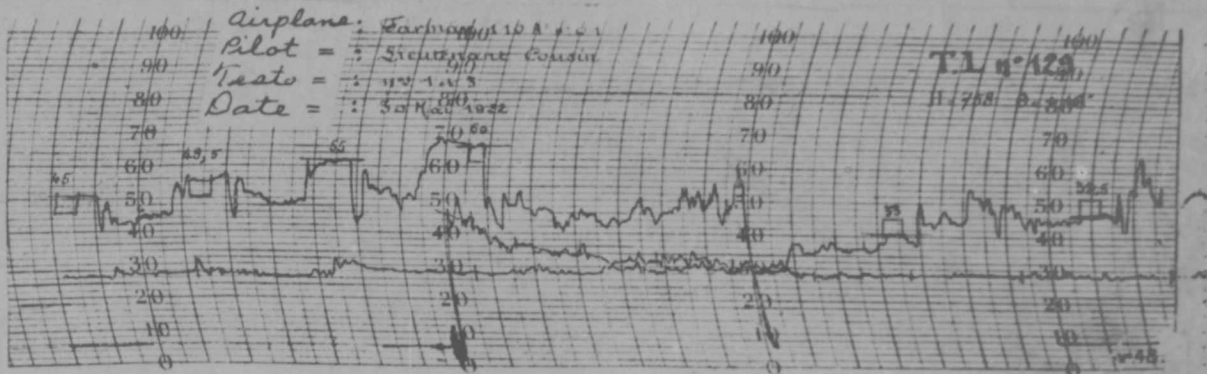


Fig. 6.- Diagram made by T.L. instrument, on which were obtained the results shown in table II

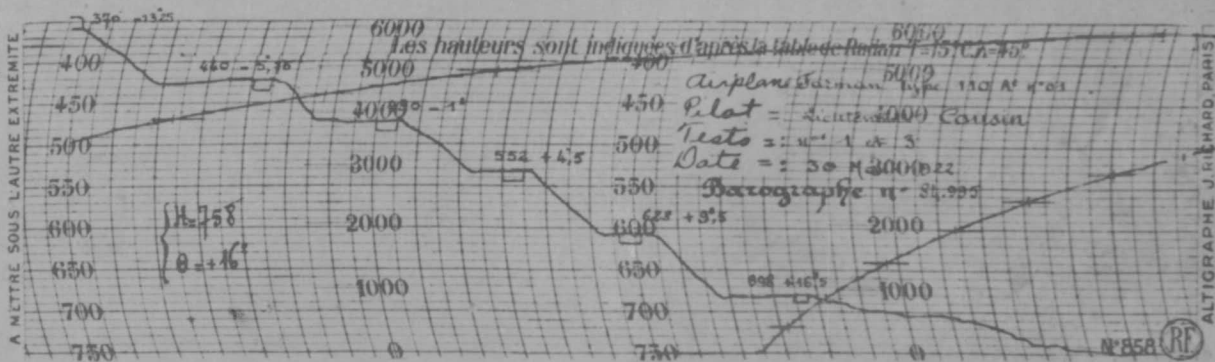


Fig. 7.- Diagram made by barograph on which were obtained the results shown in table II (The heights are indicated according to the table of Balan $T = 15^{\circ}C$ $\lambda = 45^{\circ}$)